

High performance photoelectrodes for the production of green hydrogen by artificial photosynthesis

Thesis offer at ISCR / MaCSE team/ University of Rennes

Contacts :

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Description:

The most important technological challenge of the new century is to produce and store clean, renewable and inexpensive energy. Water photoelectrolysis offers a promising solution to convert solar energy directly into hydrogen, which can be stored and used to produce electrical energy on demand, without emitting greenhouse gases.

For the past decade, the MaCSE team at ISCR Rennes has been working on artificial photosynthesis, a concept that converts solar energy into solar fuel, usually dihydrogen, for on-demand use when solar energy is no longer available. To achieve this goal, the team is preparing, modifying, and studying photoelectrodes based on photoactive semiconductor materials such as silicon and metal oxides, as well as materials from the III-V family. These results have been published in several recent publications. The MaCSE team is also partner of the "NAUTILUS" research project on decarbonized hydrogen, funded by the priority research programs and equipment (PEPR), part of the national strategy "France 2030". In that context, the aim of this thesis is to modify and determine the photoelectrochemical properties of the III-V/Si electrodes developed by the project partners using photoelectrochemical techniques. The ultimate objective is to design a self-contained, robust and low-cost photoelectrochemical cell for efficient hydrogen production. This work will be carried out in close collaboration with the partner laboratories (*FOTON-Rennes-semiconductors physics*, *CINaM-Marseille-protection/corrosion*, *C2N-Paris-Saclay-microscopy/EBIC*, *IEM-Montpellier-2D-catalysis*) and will benefit from the equipment (modification, characterization and electrochemistry) and the skills of the ISCR.

References:

B. Fabre, et al. *Acc. Mater. Res.* 2023, 4, 2, 133–142.

L. Chen, et al. *Adv. Sci.* 2022, 9, 2101661.

G. Loget, et al. *Nat. Commun.* 2019, 10, 3522.

J. Tourneur, et al. *J. Am. Chem. Soc.* 2019, 141, 11954.

Profile:

The candidate should have a Master degree, or an Engineering degree, with if possible a strong background in physical chemistry and/or solid chemistry. A particular interest in electrochemistry will be appreciated. The applicant should have a strong interest in experimental work in an interdisciplinary environment between chemistry and physics. Fluency in English is required (written and oral). Good knowledge of French is desirable.



Host laboratory:

The Institute of Chemical Sciences of Rennes (ISCR-UMR6226) is a Joint Research Unit associating the CNRS, the University of Rennes, the ENSCR and the INSA. This institute results from the merging of all the academic forces in chemistry on the site of Rennes. It brings together more than 290 permanent staff with a total of nearly 500 people in 8 teams. The researcher will be recruited in the MaCSE team and will work under the supervision of Bruno Fabre and Gabriel Loget. This project will be carried out in collaboration with the partners of the NAUTILUS project.

Other information:

Starting date: between September 1, 2023 and November 1, 2023

Thesis supervision: Bruno Fabre, Gabriel Loget

Funding: ANR PEPR NAUTILUS - France 2030

Salary: 2135 € gross monthly

Keywords: photoelectrochemistry, III-V semiconductors, silicon, hydrogen, HER, OER

Application:

Applications must be made before June 02, 2023. In this context, it is strongly recommended to contact the supervisors as soon as possible to indicate your interest in the subject.

All applications must include the following elements:

- Letter of motivation
- Detailed CV
- Copy of diplomas obtained
- Report cards

And, optionally:

- List of publications if applicable
- Letters of recommendation